

**DATA EXCHANGE METHOD AND COMMUNICATION  
PROTOCOL USED DURING SAME**

**Field of the Invention**

5                   The present invention relates in general to data communications and more specifically to a data exchange method and communication protocol used during the same.

**Background of the Invention**

10                   In the medical field, data concerning a single patient is often collected and kept at a number of locations. For example, an individual may have a medical file with a general practitioner, a medical file with a specialist, a medical file or files at a hospital etc. As a result, at any one location, a patient's medical history is incomplete.

15                   In the past, this problem even existed within hospitals where individual patients' records were kept by the various departments in the hospitals. With the introduction of database management systems and the move to computer networking solutions, this distributed information problem within hospitals has been reduced significantly. The use of computer networks has allowed patient records to be stored  
20 in a common database and accessed and updated from workstations throughout the hospital.

To deal with medical images, many hospitals use picture archiving and communication systems that enable medical images to be stored in a common database and exchanged between workstations. These picture archiving and  
25 communication systems have typically been implemented over Intranet architectures within the computer networks and make use of the Transmission Control Protocol/Internet Protocol (TCP/IP) suite of protocols during data exchange. Although the emergence of the Internet has opened communication channels between computer workstations at geographically separated locations, due to the confidential  
30 nature of medical data and the need to ensure data integrity, picture archiving and communication systems have to-date, only permitted data exchange within hospitals.

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Although picture archiving and communication systems have typically only permitted data exchange within hospitals, there is a need to be able to transmit medical image data securely across Internet connections. It is therefore an object of the present invention to provide a novel data exchange method and communication  
5 protocol used during the same.

### **Summary of the Invention**

According to one aspect of the present invention there is provided a computerized method of creating a data message for electronic transmission to a  
10 recipient comprising the steps of:

selecting at least one image file to be included in said data message;  
determining exchange rights for said recipient, said exchange rights  
establishing at least one action available to said recipient with respect to handling of  
said at least one image file; and  
15 bundling said at least one image file and said exchange rights to form  
said data message.

Preferably, during the selecting at least one image annotation, audio  
and/or text file related to the at least one image file is included in the data message.  
During the determining, preferably different categories of exchange rights are  
20 examined to locate the category the recipient to which has been assigned. If the  
recipient has not been assigned to a category, the recipient is assigned default  
exchange rights. In the preferred embodiment, the exchange rights determine whether  
the recipient is permitted to browse the at least one image file and related files,  
browse and archive the at least one image file and related files, browse and forward  
25 the at least one image and related files, or browse, archive and forward the at least one  
image and related files.

Preferably, prior to bundling, clear text in a selected related text file is  
encrypted and selected audio and/or text files are encoded. After bundling it is  
preferred that the data message is encrypted and MIME encoded.

According to another aspect of the present invention there is provided a computerized method for controlling actions available to a recipient receiving a data message from a sender, said method comprising the steps of:

- creating a data message that includes at least one image file and
- 5 exchange rights for said recipient, said exchange rights establishing at least one action available to said recipient with respect to handling of said at least one image file;
- transmitting said data message to a computer system of said recipient;
- deconstructing said data message at said recipient computer system to determine the exchange rights therein; and
- 10 permitting said recipient to perform said at least one action with said at least one image file in accordance with said exchange rights.

Preferably, the exchange rights include browse only, browse and archive, browse and forward, and browse, archive and forward rights. When a data message is transmitted, a flag is set. If a receipt acknowledgement is not received

15 from the recipient computer system within a threshold period of time, a message prompt is generated to notify the sender.

According to yet another aspect of the present invention there is provided a computerized method for communicating a data message between a sender and a recipient comprising the steps of:

- 20 from a computer system of said sender, transmitting a data message to a computer system of said recipient, said data message including at least one image file and exchange rights for said recipient, said exchange rights establishing whether said recipient is permitted to browse said at least one image file, browse and archive said at least one image file, browse and forward said at least one image file, or
- 25 browse, archive and forward said at least one image file;
- at the recipient computer system upon receipt of said data message, deconstructing said data message to determine the exchange rights therein; and
- permitting said recipient to handle said at least one image file in accordance with said exchange rights.

30 Preferably, the method further includes transmitting a reply data message to the sender computer system. When a reply data message is transmitted, a

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flag is set. If a receipt acknowledgement is not received from the original sender computer system within a threshold period of time, a message prompt is generated to notify the recipient. The reply data message includes at least one audio and/or text file and the exchange rights of the original data message.

5                   According to still another aspect of the present invention there is provided a data message structure comprising:

at least one image file; and

an exchange rights file, said exchange rights file including data fields complimentary to data fields in said at least one image file, the data fields in said  
10 exchange rights file specifying at least one recipient who is permitted access to said at least one image file and being linked to said at least one image file.

The present invention provides advantages in that it permits sensitive image data to be transmitted over the Internet in a data message that ensures image data integrity. This is achieved by assigning exchange rights to the image data, that  
15 determine whether the recipient is permitted to browse the image data, archive the image data and/or forward the image data to other recipients and by encrypting the data message to inhibit unauthorized parties from accessing the image data and the exchange rights. Whenever a data message including image data is conveyed between parties, acknowledgments are generated allowing the sender to confirm that  
20 the transmitted data message has been received. Data messages are sent in standard electronic mail (e-mail) format allowing IP address labelling to be used to direct the data messages to the desired recipients. Since e-mail addresses are used to direct data messages to recipients, the IP addresses of the recipients' computers remain hidden.

## 25    **Brief Description of the Detailed Drawings**

An embodiment of the present invention will now be described more fully with reference to the accompanying drawings in which:

Figure 1 is a schematic diagram of a data network;

Figure 2 is a flowchart showing the steps performed during creation of  
30 an exam record including at least one image file;

Figure 3 is a flowchart showing the steps performed during creation of a data message including an exam structure containing an exam record;

Figure 4 is a flowchart showing the steps performed when a recipient receives an e-mail message including a data message;

5           Figure 5 is a flowchart showing the steps performed when a recipient generates a reply e-mail message in response to a received e-mail message;

Figure 6 is a flowchart showing the steps performed by a sender when a reply e-mail message is received from a recipient; and

10           Figure 7 is a flowchart showing the steps performed by a recipient when forwarding an e-mail message that includes a data message to another recipient.

#### **Detailed Description of the Preferred Embodiment**

The present invention relates to a data exchange method and protocol for exchanging data messages including image data between computer systems over a distributed computer network such as the Internet. Image data and related data to be sent from one computer system to another computer system is initially selected from a relational database. Exchange rights are then assigned to the image data that define at least one recipient permitted or entitled to browse the image data. The exchange rights also determine if the at least one recipient is permitted to archive the image data and/or permitted to forward the image data to another recipient. The exchange rights are appended to the image data and related data and the resulting data are bundled to form a data message. The data message is then encrypted and encoded placing it in a secure condition suitable for transmission to the destination computer system in a standard electronic mail (e-mail) format.

25           When the data message is transmitted to the destination computer system and received, the destination computer system automatically acknowledges receipt of the data message. If an acknowledgement is not received by the sending computer system within a specified period of time, a prompt is generated to alert the sender. Once the data message is received and delivered to the workstation of the designated recipient, the designated recipient is able to browse, archive and/or forward the image data in the data message (provided the exchange rights permit the

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recipient to do so). If the recipient appends information to the data message and replies to the sender, the appended information is bundled with the original exchange rights to form a reply data message. The reply data message is then transmitted to the sender computer system and does not include the original image data and related data.

- 5 The appended information received by the sender is automatically integrated into the database of the sending computer system.

A preferred embodiment of the present invention will now be described with reference to Figures 1 to 7. Turning now to Figure 1, a data network is shown and is generally identified by reference numeral 10. In this example, data  
10 network 10 includes a picture archiving and communication system (PACs) 12 within a medical facility. PACs 12 communicates with another PACs 14 at a different geographical location over the Internet 16. PACs 12 includes a relational database 20, in this example an SQL database, storing a plurality of exam records that include medical image data and related data as will be described. A server 22 communicates  
15 with the database 20 and with a plurality of workstations 24 distributed throughout the medical facility. In this manner, users can access the database 20 via the workstations 24. Server 22 also communicates with a mail server 26. Mail server 26 allows users to transmit data messages over the Internet 16 in a standard e-mail format.

Each exam record in the relational database 20 includes one or more  
20 related files linked by pointers. Specifically, each exam record includes at least one image file and optionally related image annotation, audio and/or text files. Image files included in each exam record are compressed using a wavelet algorithm and are digitally watermarked to ensure integrity. The compression parameters are computed according to image modality and are stored in a .dat file format. Image annotations in  
25 each exam record are in the form of graphic objects that are stored as independent files. When an image file and related image annotations are displayed, the graphic objects of the image annotations are superimposed on the displayed image file. Audio files in each exam record are stored in a .wav file format and text files in each exam record are stored either in .txt or .doc file format. Data compression and scrambling  
30 techniques are used to encode the audio and/or text files in each exam record.

Turning now to Figure 2, a flowchart showing the steps performed during creation of an exam record is shown. As can be seen, initially a patient record is created (step 50) followed by a current exam record (step 52). Once the exam record is created, the image file or files associated with the patient that are to be included in the exam record are compressed and stored in the exam record (step 54) together with the compression parameters used to compress the image file or files (step 56). Related image annotation, audio and/or text files are then stored in the exam record (steps 57, 58 and 60) to complete the exam record and the exam record is stored in the database 20.

Each of the workstations 24 executes a data message creation application that includes a graphical user interface (GUI). The data message creation application allows a user to create data messages that include image files and optionally related image annotation, audio and/or text files associated with an exam record, together with exchange rights that determine recipients permitted to browse the image and related files, archive the image and related files and/or forward the image and related files to other recipients.

The GUI allows a user to create categories of exchange rights and assign recipients in their local address book to the created categories (see step 62 in Figure 3). In this particular example, one category of exchange rights allows recipients only to browse image files. Another category of exchange rights allows recipients to browse image files and archive image files. Another category of exchange rights allows recipients to browse image files and forward image files to other recipients while yet another category of exchange rights allows recipients to browse image files, archive image files and forward image files to other recipients.

When the user wishes to create a data message, the exam records in the database 20 are exposed through the GUI. Using a computer pointing device, the user can open an exam record. Once an exam record has been opened, the image file or files, and related image annotation, audio and/or text files within the exam record appear as icons. Individual image files within the exam record and related image annotation, audio and/or text files can then be selected using the computer pointing device.

Once the desired files within the exam record have been selected and the recipient of the exam record is designated, the data message creation application checks to determine if the recipient has been assigned to an exchange rights category (step 64). If so, the exchange rights associated with the category to which the  
5 recipient has been assigned are selected (step 66). If the recipient has not been assigned to a category, default exchange rights are selected (step 68). Once the exchange rights for the recipient have been determined, the exchange rights are appended to the selected exam record files to form an exam structure (step 70).

The exchange rights are stored in independent files that include data  
10 fields complimentary to data fields in the exam record image file or files. The data fields are linked to the associated image file by file name. In this particular example, the data fields hold information that define user browsing rights, user archiving rights, the archiving duration and user forwarding rights.

After the exchange rights have been appended to the exam record  
15 image file or files, clear data files such as the text files in the exam structure are encrypted (step 72) and the exam structure is bundled (step 74) to complete the data message. Following this, the data message is encrypted and MIME encoded (step 76). The encrypted and MIME encoded data message is then attached to a conventional e-mail message and sent to the recipient PACs 14 over the Internet by the mail server 26  
20 (step 78). A flag is then set to a "wait\_for\_receive" state (step 80). If an acknowledgement is received from the recipient PACs 14 confirming receipt of the e-mail message within a predetermined period of time (step 82), the wait\_for\_receive flag is reset (step 86). Otherwise, a message prompt is generated and sent to the sender's workstation 24 to notify the sender (step 84).

25 When the e-mail message arrives at the destination, the e-mail message is received by the mail server 26 PACs 14 and is delivered to the mailbox of the recipient. When the recipient retrieves the e-mail message, the data message is retrieved from the mail server (see step 88 in Figure 4). Once retrieved, the data message is deconstructed firstly by MIME decoding and decrypting the data message  
30 (step 90). Afterwards, the data message is debundled (step 92) and all clear text files in the exam structure are decrypted (step 94). The exchange rights are then extracted



from the exam structure starting with the browsing rights (step 96), then the archiving rights (step 98) and then the forwarding rights (step 100). The exam record image and related files are then recovered from the exam structure (step 102) and the exam record image and related files together with the exchange rights are cached (step 104).

- 5 An acknowledgment is returned to the sender PACs 12 to verify receipt of the data message (step 106).

With the exam record image and related files cached and the receipt acknowledgement returned to the sender PACs 12, status flags associated with browsing, archiving and forwarding are reset (step 108). The exchange rights are then

- 10 analyzed to check the browsing, archiving and forwarding rights (step 110).

“Allow\_browsing”, “Allow\_forwarding” and “Allow\_archiving” status flags are set to false if the associated exchange rights inhibit the recipient from browsing, archiving and/or forwarding image and related files in the record (steps 112). If the recipient has browsing rights, the image file or files and accompanying related image

- 15 annotation, audio and/or text files can be displayed and/or reviewed (block 114). If the recipient has archiving rights, the image file or files and accompanying related image annotation, audio and/or text files can be stored in the database 20 for a duration determined by the archiving duration rights.

If the recipient elects to reply to the sender, the recipient can respond

- 20 by creating an audio file and/or a text file. Once an audio and/or text file has been created, the created file and a copy of the original exchange rights are packaged to form an exam structure (see step 116 in Figure 5). Any clear text in a created text file in the exam structure is encrypted (step 118) and the exam structure is bundled (step 120) to form a reply data message. The reply data message is then encrypted and
- 25 MIME encoded (step 122) and is attached to a conventional e-mail message. The e-mail message is then sent to the sender PACs 12 by the mail server 26 over the Internet 16 (step 124). A flag is then set to a wait\_for\_receive state (step 126). If an acknowledgment is received from the original sender PACs 12 confirming receipt of the reply data message within a predetermined period of time (step 128), the flag is
- 30 reset (step 132). Otherwise, a message prompt is generated and sent to the recipient’s workstation 24 to notify the recipient (step 130).

When the reply e-mail message arrives at PACs 12, the e-mail message is received by the mail server 26 and is delivered to the mailbox of the original sender. When the original sender retrieves the e-mail message, the reply data message is retrieved from the mail server 26 (see step 134 in Figure 6). Once  
5 retrieved, the reply data message is MIME decoded and decrypted (step 136) and the reply data message is debundled (step 138). All clear text files in the exam structure are then decrypted (step 1450). The exam structure is examined to confirm it relates to a reply (step 142) and then the database 20 is examined to determine if an exam record exists in the database that relates to the reply (step 142).

10 If an exam record exists in the database 20, the audio and/or text files in the reply data message are added to the exam record in the database (step 150). If an exam record does not exist in the database 20, a new exam record is created in the database (step 146) and the audio and/or text files in the reply data message are added to the new exam record (step 148). Once the audio and/or text files have been stored  
15 in the database 20 either at step 108 or step 110, an acknowledgment is returned to the recipient PACs 14 to confirm receipt of the reply data message (step 152).

If the recipient elects to forward the data message to another recipient, the forwarding rights are examined (see step 154 in Figure 7). If the recipient does not have forwarding rights, the recipient is inhibited from performing this task (step  
20 156). If the recipient has forwarding rights, the local address book of the recipient is checked to determine if the new recipient has been assigned exchange rights. Exchange rights assigned by the recipient can further restrict the rights of the new recipient but not expand the exchange rights established by the original sender. If the new recipient has been assigned exchange rights that further restrict the rights of the  
25 new recipient, those exchange rights are included in the exam structure. Otherwise the exchange rights established by the original sender are included in the exam structure. Following this, clear text in text files in the original exam structure are encrypted (step 158) and clear text in text files appended to the exam structure by the recipient are also encrypted (step 160). The exam structure and appended files are  
30 bundled (step 162) to form the forwarding data message and the forwarding data message is encrypted and MIME encoded (step 164). Following this, the forwarding

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data message is attached to a conventional e-mail message and is forwarded to the new recipient by the mail server (step 166). A flag is then set to a wait\_for\_receive state (step 168). If an acknowledgment is received from the new recipient PACs confirming receipt of the forwarding data message within a predetermined period of  
5 time (step 170), the flag is reset (step 174). Otherwise, a message prompt is generated and sent to the recipient's workstation to notify the recipient (step 172).

As will be appreciated, the present invention permits sensitive image data to be transmitted over the Internet while ensuring data integrity. This is achieved by assigning exchange rights to image data, which determine recipients permitted to  
10 browse the image data, archive the image data and/or forward the image data and by encrypting the data message to inhibit unauthorized access to the image data and exchange rights. Whenever image data is conveyed between parties, acknowledgments are generated allowing the sender of the data message to confirm that the transmitted data message was received.

15 Although a preferred embodiment of the present invention has been described herein in detail, it will be understood by those skilled in the art that variations and modifications may be made without departing from the spirit and scope thereof as defined by the appended claims.

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